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Observations of Phenomena of Jupiter's Satellites, at Windsor, New South Wales, in the year 1887. By J. Tebbutt.

Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase. h m s	Correction to Nautical Almanac. m s
1887, Mar. 17	I.	Ecl. D.	Last seen	8-inch	170	10 25 59·4	+ 0 56·6
25	I.	Tr. Ingr.	Ext. contact	,,	,,	9 59 23·0	
25	I.	,,	Int. contact	,,	,,	10 3 52·3	
25	III.	Ecl. D.	Began to fade	,,	,,	10 59 57·9	
25	III.	,,	Last seen	,,	,,	11 8 28·5	+ 6 14·7
25	III.	Ecl. R.	First seen	,,	,,	12 50 58·9	− 1 24·9
25	III.	,,	Full brightness	,,	,,	12 59 53·0	
April 2	I.	Ecl. D.	Began to fade	4½-inch	130	8 38 53·9	
2	I.	,,	Last seen	,,	,,	8 40 53·1	+ 0 36·3
7	II.	,,	Began to fade	8-inch	170	10 13 39·5	
7	II.	,,	Last seen	,,	,,	10 16 21·0	+ 0 28·2
9	I.	,,	Began to fade	,,	,,	10 32 51·8	
9	I.	,,	Last seen	,,	,,	10 34 47·0	+ 0 56·2
10	I.	Tr. Ingr.	Ext. contact	4½-inch	130	7 56 16·5	
10	I.	,,	Int. contact	,,	,,	8 0 30·8	
10	I.	Tr. Egr.	Int. contact	8-inch	170	10 3 30·2	
10	I.	,,	Ext. contact	,,	,,	10 7 24·6	
23	II.	Tr. Ingr.	Ext. contact	,,	,,	10 13 4·2	

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Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase. h m s	Corrected to Nautical Almanac. m s
1887, Apr. 23	II.	Tr. Ingr.	Bisection	8-inch	170	10 16 33·7	
23	II.	,,	Int. contact	,,	,,	10 19 33·2	
25	II.	Ecl. R.	First seen	4½-inch	130	7 19 10·3	+ 2 14·5
30	III.	,,	First seen	8-inch	170	8 35 44·7	− 3 2·1
30	III.	,,	Full brightness	,,	,,	8 42 46·1	
May 3	I.	Tr. Ingr.	Ext. contact	,,	,,	7 35 46·2	
3	I.	,,	Bisection	,,	,,	7 37 35·9	
3	I.	,,	Int. contact	,,	,,	7 39 5·6	
7	III.	Occ. D.	First contact	,,	,,	9 19 9·5	
7	III.	,,	Last seen	,,	,,	9 35 6·9	
7	III.	Ecl. R.	First seen	,,	,,	12 33 7·2	− 3 24·6
7	III.	,,	Full brightness	,,	,,	12 46 35·0	
9	I.	Occ. D.	First contact	,,	,,	12 9 11·9	
9	I.	,,	Bisection	,,	,,	12 11 11·5	
9	I.	,,	Last seen	,,	,,	12 13 1·2	
9	II.	Ecl. R.	First seen	,,	,,	12 30 29·8	+ 0 35·0
9	II.	,,	Full brightness	,,	,,	12 34 7·7	
10	I.	Tr. Ingr.	Ext. contact	,,	,,	9 20 40·4	
10	I.	,,	Int. contact	,,	,,	9 23 39·9	
11	I.	Ecl. R.	First seen	,,	230	9 13 35·1	− 0 0·7

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Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase h m s	Correction to Nautical Almanac. m s
1887, May 11	I.	Ecl. R.	Full brightness	8-inch	230	9 16 11·2	
25	III.	Tr. Egr.	Bisection	,,	138	7 11 40·6	
25	III.	,,	Ext. contact	,,	,,	7 19 9·4	
25	II.	Tr. Ingr.	Ext. contact	,,	230	8 23 48·6	
25	II.	,,	Bisection	,,	,,	8 24 58·4	
25	II.	,,	Int. contact	,,	,,	8 26 48·1	
25	I.	Occ. D.	First contact	,,	,,	10 7 11·4	
26	I.	Tr. Ingr.	Ext. contact	,,	138	7 17 39·1	
26	I.	,,	Int. contact	,,	,,	7 22 8·4	
June 3	I.	Ecl. R.	First seen	,,	230	9 24 37·4	− 0 6·4
3	I.	,,	Full brightness	,,	,,	9 27 12·9	
3	II.	,,	First seen	,,	,,	9 40 11·3	+ 0 23·5
3	II.	,,	Full brightness	,,	,,	9 43 10·3	
12	I.	,,	First seen	,,	,,	5 47 46·8	+ 0 3·0
12	I.	,,	Full brightness	,,	,,	5 50 50·3	
12	III.	Ecl. D.	Began to fade	,,	138	6 41 21·9	
12	III.	,,	Last seen	,,	,,	6 51 45·1	+ 5 47·3
12	III.	Ecl. R.	First seen	,,	,,	8 22 57 5	− 3 14·3
12	III.	,,	Full brightness	,,	,,	8 33 23 2	
18	I.	Tr. Ingr.	Ext. contact	,,	,,	7 10 38 9	

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Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase.	Correction to Nautical Almanac.
						h m s	m s
1887, June 18	I.	Tr. Ingr.	Bisection	8-inch	138	7 12 38·6	
18	I.	,,	Int. contact	,,	,,	7 15 8·2	
18	I.	Tr. Egr.	Int. contact	,,	,,	9 19 2·5	
18	I.	,,	Bisection	,,	,,	9 23 56·7	
18	I.	,,	Ext. contact	,,	,,	9 26 16·3	
19	III.	Occ. D.	First contact	,,	,,	5 58 20·7	
19	III.	,,	Bisection	,,	,,	6 3 34·8	
19	III.	,,	Last seen	,,	,,	6 6 49·3	
19	II.	Tr. Egr.	Int. contact	,,	,,	7 8 39·0	
19	II.	,,	Bisection	,,	,,	7 13 8·2	
19	II.	,,	Ext. contact	,,	,,	7 16 52·6	
19	I.	Ecl. R.	First seen	,,	,,	7 41 55·4	– 0 16·4
19	I.	,,	Full brightness	,,	,,	7 45 17·8	
19	III.	Occ. R.	First seen	,,	,,	7 58 30·6	
19	III.	,,	Last contact	,,	,,	8 5 29·5	
19	III.	Ecl. D.	Began to fade	,,	,,	10 40 33·6	
19	III.	,,	Last seen	,,	,,	10 52 0·7	+ 6 20·9
25	I.	Tr. Ingr.	Ext. contact	,,	,,	9 1 58·8	
25	I.	,,	Bisection	,,	,,	9 4 18·4	

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Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase. h m s	Correction to Nautical Almanac. m s
1887, June 25	I.	Tr. Ingr.	Int. contact	8-inch	138	9 6 33·1	
26	II.	,,	Ext. contact	,,	,,	7 5 7·7	
26	II.	,,	Bisection	,,	,,	7 6 47·4	
26	II.	,,	Int. contact	,,	,,	7 9 2·0	
26	III.	Occ. D.	First contact	,,	,,	9 37 42·2	
July 14	III.	Tr. Ingr.	Ext. contact	,,	300	7 4 0·5	
14	III.	,,	Bisection	,,	,,	7 8 29·8	
14	III.	,,	Int. contact	,,	,,	7 15 13·6	
14	III.	Tr. Egr.	Bisection	,,	230	9 17 38·2	
14	III.	,,	Ext. contact	,,	,,	9 23 7·3	
18	I.	Tr. Ingr.	Ext. contact	,,	138	9 10 37·4	
18	I.	,,	Bisection	,,	,,	9 12 47·0	
18	I.	,,	Int. contact	,,	,,	9 15 21·6	
21	II.	Tr. Egr.	Bisection	,,	230	6 31 46·8	
21	II.	,,	Ext. contact	,,	,,	6 35 11·2	
25	III.	Ecl. D.	Began to fade	,,	,,	6 36 28·5	
25	III.	,,	Last seen	,,	,,	6 47 19·7	+ 6 1·9
25	III.	Ecl. R.	First seen	,,	,,	8 14 10·1	− 3 1·7
25	III.	,,	Full brightness	,,	,,	8 23 40·6	

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Day of Observation.	Satellite.	Phenomena.	Phase.	Aperture of Telescope.	Mag. Power.	Windsor Mean Time of Phase.	Correction to Nautical Almanac.
						h m s	m
887, July 27	I.	Tr. Egr.	Int. contact	8-inch	138	7 46 46·3	
27	I.	,,	Ext. contact	,,	,,	7 52 15·3	
28	I.	Ecl. R.	First seen	,,	,,	6 12 23·6	− 0 17·2
28	I.	,,	Full brightness	,,	,,	6 14 1·3	
28	II.	Tr. Ingr.	Ext. contact	,,	230	6 31 48·4	
28	II.	,,	Bisection	,,	,,	6 33 28·1	
28	II.	,,	Int. contact	,,	,,	6 35 27·8	
28	II.	Tr. Egr.	Int. contact	,,	138	9 4 3·0	
28	II.	,,	Bisection	,,	,,	9 7 32·4	
28	II.	,,	Ext. contact	,,	,,	9 11 16·8	
30	II.	Ecl. R.	First seen	,,	,,	6 37 40·8	+ 0 15·0
30	II.	,,	Full brightness	,,	,,	6 42 26·5	
Aug. 1	III.	Occ. R.	Last contact	,,	230	7 30 15·5	
3	I.	Tr. Ingr.	Ext. contact	,,	138	7 32 33·2	
3	I.	,,	Bisection	,,	,,	7 34 42·8	
3	I.	,,	Int. contact	,,	,,	7 37 12·4	
6	II.	Ecl. R.	First seen	4½-inch	120	9 15 11·5	+ 0 51 7
6	II.	,,	Full brightness	,,	,,	9 17 55·0	
Sept. 12	I.	,,	First seen	8-inch	230	6 38 15·0	− 0 4·8
12	I.	,,	Full brightness	,,	,,	6 40 59·5	

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Remarks.

March 17.—Sky clear; slight boiling of the planet's limb.

March 25.—Sky clear. Bad definition and images unsteady at ingress. Definition somewhat improved during the eclipse. Satellite suspected at $12^{h}\ 50^{m}\ 31^{s}.5$. Reappearance difficult to observe in consequence of the satellite's proximity to the limb.

April 2.—Clear sky and good definition. Good observation.

April 7.—A very thin cloud passed over at the critical time, but did not appear to dim the satellites. Excellent definition. Satellite suspected again at $10^{h}\ 16^{m}\ 38^{s}.6$.

April 9.—Sky beautifully clear, but the Moon very bright and near the planet.

April 10.—Definition pretty good throughout.

April 23.—Definition pretty good, but images unsteady.

April 25.—Reappearance noted just as the planet was emerging from a cloud, and satellite then tolerably well seen.

April 30.—Planet very slightly dimmed by faint cloud when satellite first seen; satellite suspected a few seconds earlier. Reappearance very slow, and full brightness difficult to determine.

May 3.—Definition not good.

May 7. Definition fairly good. Disappearance very gradual, owing to the inclination of the planet's limb. Sky beautifully clear at the reappearance, and the definition fairly good. Full Moon distant a few degrees from the planet. The recovery of the satellite's light was very gradual, and at greatest brightness it slightly surpassed satellite I. near it.

May 9.—Definition pretty good at the occultation, and better at the eclipse. The observation of reappearance was rather late and the full brightness could not be well determined.

May 10.—Definition very bad.

May 11.—Steadiness and definition satisfactory. Satellite suspected at $9^{h}\ 13^{m}\ 26^{s}.6$. Full brightness difficult to determine.

May 25.—Definition fair at ingress of III. Images steady and well defined at ingress of II. Planet faint and badly defined at occultation of I.

May 26.—Fair definition.

June 3.—Sky beautiful and the images steady and well defined. Planet a few degrees distant from the Moon.

June 12.—Beautifully clear, but the definition at the eclipse of I. was not good. Observation probably rather late. Images rather tremulous at disappearance of III. III. lost about half its light by $6^{h}\ 45^{m}\ 41^{s}.2$, and was suspected at $6^{h}\ 52^{m}\ 0^{s}.1$. Definition better at reappearance.

June 18.—Definition better at ingress than at egress; the internal contact at egress was probably observed too early.

June 19.—Total disappearance of III. in occultation; doubtful in consequence of a passing cloud. Planet and satellite faint at egress of II. Sky beautifully clear at reappearance of I., and images bright, steady, and well defined. Definition not so good at the last contact at reappearance of III. Sky still clear at disappearance of III. and images steady and well defined. Satellite glimpsed again at $10^{h}\ 52^{m}\ 26^{s}.6$.

June 25.—Good definition.

June 26.—Sky clear and definition good at ingress of II. Clouds prevented further observation of III.

July 14.—Definition fairly good at the external but not so good at the internal contact at ingress. Planet faint and badly defined at egress.

July 18.—Definition good at the external contact, but bad at the other phases. Satellite IV., which was about in conjunction with the planet's centre, was remarkably dull and faint.

July 21.—Definition pretty good.

July 25.—Definition pretty good at both phases, but Moon near planet.

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July 27.—Definition bad at internal but better at external contact.

July 28.—Sky beautifully clear. Definition fair at reappearance of I., but much disturbed during the other observations.

July 30.—Sky beautifully clear, and good definition.

Aug. 1.—Definition pretty good.

Aug. 3.—Fair definition.

Aug. 6.—Sky beautifully clear, and definition good; but satellite rather conspicuous when first seen.

Sept. 12.—Sky clear, and definition good; the twilight, however, had not quite disappeared.

Windsor, N.S. Wales:
1887, *November* 28.

Ephemeris of the Satellites of Mars, 1888. By A. Marth.

The values of the longitude of the node N and of the inclination J of the orbit of *Deimos*, in reference to the plane parallel to the Earth's equator, which have been employed in the following ephemeris are

$$N = 49^\circ\ 549, \qquad J = 36^\circ{\cdot}029.$$

The assumed proportion of the mass of the Sun to that of *Mars* is

$$\odot = 3095000.$$

The orbital longitude of *Deimos*, reckoned from the node, is

$$u_2 = 145^\circ{\cdot}80 + 285^\circ{\cdot}1620\,(t - t_0),$$

the epoch t_0 being 1888, April, 12·0 Gr.

Phobos is assumed to move in the plane of the orbit of *Deimos*, and its longitude is taken to be

$$u_1 = 101^\circ{\cdot}16 + 1128^\circ{\cdot}8490\,(t - t_0),$$

its value being somewhat uncertain, as no observations of the satellite made during the last opposition have become known.

a, b, major and minor semi-axes of the apparent ellipses described by the satellites.

P, position-angle of the minor axes in the direction of superior conjunction.

$U + 180^\circ$ and B, areocentric longitude and latitude of the Earth referred to the plane of the orbit of *Deimos*, and reckoned from the node.

$u - U$ longitudes of the satellites, reckoned in their orbits from the points which are in superior conjunction with the planet's centre.